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Insights from precise geological study to determine hydrosystems interconnections nearby anticlines: the example of the Cenomanian aquifer in South Gironde (France)

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At regional scale, local structural deformations are often neglected in large extension aquifer studies. However structural deformations are a key element to understand aquifer systems. For instance, anticlines have a major impact on the nature and geometry of the deposits: lateral facies variations, thicknesses variations and faults can occur. Pluridisciplinary work is needed at local scale to have a detailed characterization of these objects and to quantify their influence on the aquifer system.

The Aquitain Basin is a sedimentary basin which contains a regional multi-layer aquifer system, affected by multiscale structural and tectonics events. In this system, the possible exploitation of the Cenomanian aquifer as a new water supply has been studied in the South Gironde, nearby Bordeaux City (France). Before any exploitation, it is essential to understand the interconnections that can exist between the Cenomanian aquifer, the overlying aquifers and surface water (such as ponds). Those connections are induced by the geometry of the aquifer and semi-permeable layers, their extension and the nature of sedimentary bodies.

These geometries are complex due to the geodynamic history of the area, which is a part of the Aquitain Basin that was deformed during the Pyrenean compression. Aquifer reservoirs are affected by anticline structures and major faults. At the Villagrains-Landiras anticline, where the Cenomanian aquifer is shallow enough to be exploited for drinkable water, geological data in the literature is not enough precise at local scale to determine the extension of the reservoirs and impermeable layers. An extensive research program was developed including reconnaissance drilling (10 core drillings and 5 destructive drillings), water level measurements, geochemical analysis, petrophysical tests.

This methodology combining different fields allows a better understanding of the tertiary and late cretaceous sedimentary architecture and nature. A high resolution geological model has been created combining the new precise data with what was published before. Geological architecture model and petrophysical data from the cores are implemented inside a hydrogeological model. This heuristic hydrogeological model allows to understand flowing and interconnections inside the multilayer aquifer system and with surface water. Geochemical data are used to understand the local recharge/discharge phenomenon and to constrain the model. It reveals that the bevels extension of the tertiary geological layers near the anticline is a major key to understand aquifer interconnections. Detailed characterization of the anticline structure allows to understand hydrogeological observations which were not explained before. It particularly highlights the role of faults on preferential flows. Such model is necessary to make a decision regarding the exploitation of the Cenomanian aquifer.